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A study of the comparative value of predictive tests administered in the Univeristy High School 1946-1948.

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A STUDY OF THE COMPARATIVE VALUE OF PREDICTIVE TESTS ADMINISTERED IN THE UNIVERSITY HIGH SCHOOL 1946 TO 1948

A DISSERTATION

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The undersigned hereby certify that they have read and do recommend to the Committee on Graduate Studies for acceptance, a dissertation on "A Study of the Comparative Value of Predictive Tests Administered in The University High School" submitted by William Moysa, B. Ed. in partial fulfilment of the requirements for the degree of Master of Education.

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Chapter I Introduction.

1. Purpose of the Investigation.

In the past, schools have adopted various testing programs aimed at making an assessment of the potential abilities and achievements of their students. The predictive value of tests in such programs has seldom been fully appraised and such tests have been replaced by newer ones with little improvement in results. It is on the analysis of the predictive value of certain commonly used tests that this study is based.

An attempt has been made to set up a statistically valid method of comparing the tests in question, with the more specific aim of determining which tests seem to show the greatest promise in predicting scholastic achievement in the high school.

2. The Problem.

The testing program of the University High School of Edmonton, which furnishes the data for this study, extends over two years and consists of six intelligence tests and two reading

achievement tests. The question, Do any of these tests show distinct superiority in predicting academic achievement in this particular high school? has been consistently borne in mind throughout the analysis. As a subsidiary problem the reading achievement tests have been subjected to statistical analysis in an attempt to answer the question, Which of these tests has proven better than others in predicting English Achievement in this particular high school?

Any attempt to reach definite conclusions concerning the main problem and its subsidiary necessitates making comparisons of the differences in predictive value of these tests at each grade level. In doing so, comparison of the test scores themselves was a temptation which had to be avoided constantly.

Chapter II History of the Predictive Tests Employed

1. The Testing Program

The group tests analyzed in this study are as follows: Intelligence Tests: Laycock, Willis-Smith, Henmon-Nelson (A), Henmon-Nelson (B), Otis, and the American Council of Education. Reading Tests: Nelson-Denny, and the Government Reading Test, a reading achievement test developed by the Department of Education and administered in Alberta High Schools.

In order to make this study more comprehensible to the reader it was felt that a survey of available, authoritative opinion[1] about each test was desirable.

(1) Laycock Intelligence Test

Validity: This test yields averaged r's of .67, .81, .59 when correlated with other intelligence tests, teachers' judgments of students and averaged school marks respectively.

Reliability: Test re-test correlation coefficient for 40 pupils was .80. By the split-half method for a random sample of 195 pupils an r of .95 was obtained. Other test makers report similar coefficients of reliability.

(2) Willis-Smith Advanced Mental Test, Forms "A" and "B".

This test resembles the Otis Self-Administering Tests of Mental Ability-----"probably not as good as other mental tests for High School grades".[1] There is no information available on validity, item validity, reliability, and sample used in establishing norms in either the test manual or the publisher's catalogue.

(3) Henmon-Nelson Tests of Mental Ability, "A" and "B".

Two equivalent forms of this test are available for testing in the High School. They are sometimes designated as VGCI "A" and "B" and are published in large cardboard forms. Their reliability is high, running in the high .80's and .90's. As for validity, the test correlates from .75 to .90 with other good intelligence tests. It correlates from .45 to .65 with course marks and grade averages in college.[2]

(4) Otis-Quick-Scoring Mental Ability Tests, Gamma C and D.

Reviews in Buros do not furnish statistics as to the validity and reliability of this test. However, F. Kuder, Professor of Psychology, Duke University states that....."For purposes of prediction of school and college success these tests compare favorably with other measures of general ability. Recent studies have indicated a higher relationship between the American Council and the Otis, with the latter showing as high, or higher, relationship to college grades. There is some evidence to indicate that when I.Q.'s on the Otis and famous individual tests are compared, the I.Q.'s of the Otis will correspond more closely with those of the Wechsler-Bellevue than those of the Stanford-Binet."[1]

(5) American Council for Education Intelligence Test.

Reviewed by C.I. Hovland, Professor of Psychology, Yale University.

Reliability: "On this point we must rely on data from analogous tests prepared by the same authors and upon their general reputation as careful workers. One would estimate the reliability to be reasonably high....."[1]

Validity: "Validity is based on a priori relevance of the material to the scholastic aptitude and the similarity of the tests to others which have been validated in school situations.[1] No statistics were available on the reliability and validity of this test.

(6) Nelson-Denny Reading Test.

There are two parts to this test, Vocabulary and Paragraphs, with a time limit imposed in each part. A reading rate of 300 words per minute is required to finish the Paragraphs part of the test.

As reported by H.C. Gordon, Division of Educational Research, Philadelphia, a correlation coefficient of validity of .70 was obtained when the test was correlated with an objective psychological test. He also reports a reliability correlation coefficient of .91.[3]

(7) Government Reading Tests.

These tests are not listed in Buros. There are four parts: Vocabulary, Rate, Comprehension and Accuracy. Since each part is scored in different units there is no total score.

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Chapter III Experimental Design

1. Source of the Data

The data used were obtained from the records of the University High School covering the two academic years, 1946-47 and 1947-48. During these two years the testing program in this high school consisted of the group predictive tests outlined in Chapter II together with the Kuder Preference Record with which this study is not concerned.

For the purpose of this analysis the raw scores of each predictive test were desirable but were not always available. The Laycock, Willis-Smith, Henmon-Nelson "A" and "B" and the Otis Intelligence Test scores are in terms of I.Q. points while the American Council has a raw total score for which no I.Q. conversion scale is at present used. The Reading Test data are all in terms of raw scores.

Academic achievement and English achievement in each grade is expressed as a percentage. However, to indicate academic achievement, the mean has been taken of each student's marks in the high school academic electives chosen in each grade, whereas for English achievement no such average was necessary. In many cases, the mean of students' achievement in academic electives

over the two years in Grade XII was considered an indication of their academic achievement in that grade.

2. Method

In the initial stage of the analysis considerable compilation of data was required. To facilitate rapid handling of the data an indexed card system was deemed most expedient. Each data card was divided into two separate parts. On one side was recorded a student's predictive test record, while on the other side was recorded his marks for each subject. A typical data card follows.

1.		X	XI	XII
Test		46-47	47-48	48-49
1. Laycock		126	126	
2. W-S		126	126	
3. VGCI	A	121	121	
	B		117	
4. Otis			125	
5. Am.	L	63		
Council	Q	33		
	T	99		
6. Govt.	V	38	55	49
Reading	R	449	289	312
	C	122	77	91
	A	88	87	72
7. Nelson-	V	18	22	
Denny	P	46	54	
	T	64	76	
8. Kuder Preference		8 Literary 4 Computational 7 Artistic		

	X	XI	XII
Subject	46-47	47-48	48-49
1. English	75	75	
2. Soc. Studies	75	80	
3. Health	80		
4. P.T.	85		
5. Algebra	70		
6. Trigonometry			
7. Geometry		75	
8. Chemistry		75	
9. Physics	85		
10. French	75	80	
	Av. 76.7	Av. 76.7	
11. Bookkeeping			
12. Gen. Shop			
13. Typewriting	75		
14. Home Economics			
15. Art, Music, Drama		Psy. S. Ed.	
16. Misc. Electives		85 80	
17. Biology			

Figure 1. Student Data Card.

All the information that is required about any one student is to be found on his individual card. In addition, each card is almost completely anonymous, having on it only a code number which is listed in a key beside a particular student's name.

With all the information compiled, the next stage was to compute Pearson's coefficient of linear correlation for each of the following combinations in each grade.

(a) Intelligence test scores vs. academic achievement scores

(b) Reading test scores vs. academic achievement scores

(c) Reading test scores vs. English achievement scores.

From a statistical point of view it was considered important to select as large a group as possible in computing each r. Hence no equality in the size of groups was expected, although with but one or two exceptions the number in each group ranged from 100 to 115 in Grades $\underline{X}$ and $\underline{XI}$. In Grade $\underline{\underline{XII}}$ the number in each group ranged from 145 to 155. Briefly summing up the above, each group can be considered a relatively small sample drawn from a larger parent population, a certain grade in the University High School, and consists of as large a number of students as it was possible to secure.

The product-moment method of computing Pearson's r was considered sufficiently adequate, considering the number of computational checks, and was used throughout. The illustrative scatter-diagram and computation of r is almost self-explanatory.[1] The formula for r is:--

$$r = \frac{p_{u_1 u_2}}{\sigma_1 \sigma_2}$$

where U_1 is the computation variable for the predictive test scores.

U_2 is the computation variable for the scholastic achievement scores.

$$\rho_{U_1U_2} = \overline{U_1U_2} - \overline{U}_1\,\overline{U}_2$$

$$\sigma_1 = \sqrt{\overline{U_1^2} - \overline{U}_1^2}$$

$$\sigma_2 = \sqrt{\overline{U_2^2} - \overline{U}_2^2}$$

The standard error of r was computed from the formula:

$$\sigma_r = \frac{(1 - r^2)}{\sqrt{N - 1}}$$

Computing the correlation between the Government Reading Test and academic achievement or English achievement created a problem because of the fact that no total score is possible in raw score units. Rather than resort to a multiple correlation technique, it was decided to consider each of the parts separately. Thus, for the purposes of this analysis one of the reading tests consists of four sub-tests which measure four different aspects of reading achievement. These aspects are reading vocabulary, reading rate, reading comprehension and reading accuracy.

The final stage of the study consisted first of the application of tests of significance to the r's obtained, and then, for purposes of comparison, testing the significance of differences between r's. First, it was necessary to determine whether the r's for one test were significantly different between grades. Here, use of Fisher's z-function proved feasible since the r's of the two samples compared were independent. However, serious difficulty was experienced in testing the significance of differences of r's in one grade (comparing the predictive value of two tests in one grade.) In such a situation each coefficient has one array (viz. academic achievement or English achievement) which is common to the

other. A method of surmounting this difficulty with large, normally distributed populations has been developed by Pearson and Filon.[2] For the purpose of this study it was decided that use of this formula would increase the significance of the analysis. The argument for this procedure is as follows:--

Fisher's z-function in computing a critical ratio uses the following formula:

$$C.R. = \frac{z_1 - z_2}{\sigma_{(z_1 - z_2)}}$$

where $$\sigma_{(z_1 - z_2)} = \sqrt{\sigma_{z_1}^2 + \sigma_{z_2}^2 - 2 r_{z_1 z_2} \sigma_{z_1} \sigma_{z_2}}$$

For samples where z_1 and z_2 are independent, the correction factor in this formula is zero since $r_{z_1 z_2}$ is zero. For samples where z_1 and z_2 are dependent (e.g. where a common array is used) then the correction factor, if positive, decreases the value of $\sigma_{(z_1 - z_2)}$ and, in effect increases the critical ratio. The main difficulty is the calculation of $r_{z_1 z_2}$ or in the Pearson-Filon formula, $r_{r_1 r_2}$, a laborious process served by the following formula:--

$$r_{r_{12} r_{13}} = r_{23} - \frac{r_{12} r_{13} (1 - r_{23}^2 - r_{12}^2 - r_{13}^2 + 2 r_{23} r_{12} r_{13})}{2 (1 - r_{12}^2)(1 - r_{13}^2)}$$

Since the nature of such a formula involves much labor the following guide to the conditions warranting its use was drawn up.

(1) Where a CR by Fisher's z-function is insignificant the Pearson-Filon formula is not used.

(2) Where a CR is almost significant the formula is used.

(3) Where a CR is significant the formula is not used.

Even the use of the above guide, it was felt, would not sufficiently

reduce the number of occasions for the use of the Pearson-Filon formula. As a result, it was decided that comparisons of predictive values would be adequately served if we were to take several typical examples where the critical ratios neared significance and apply the formula. For the remaining cases where this formula might raise the critical ratio to a significant level it was decided to make a mark beside the CR denoting that the test is "almost significant".

3. Criteria of Prediction.

Each test was evaluated in terms of its individual relationship with academic achievement in each grade. Thus, academic achievement was a common basis upon which the predictive value of a test was determined. Similarly, the criterion, English achievement, was utilized to examine further the value of the reading tests as predictors of high school achievement.

To make valid comparisons of the differences of predictive values between tests, the r's of each test in each grade were tested for significance of differences by the technique already described.

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PART II ANALYSIS OF DATA

Chapter IV. Prediction of Academic Achievement by Intelligence Tests.

1. Nature of the Distributions of the Intelligence Test Data.

The grouped frequency distribution for each of the intelligence tests studied will be found classified for ready comparison from grade to grade in the following tables. Since the American Council employs no I.Q. conversion scale it was impossible to compare its distributions with those of the other tests. Hence it was decided that no disadvantage would result if this distribution were omitted.

From Table I it is evident that each test consistently shows fewer students with low I.Q.'s in Grade XII than in Grade X. This illustrates the obvious truth that advancement through the grades is affected by mental ability. The upper limit of the I.Q. range, except for four cases, remains constant from Grade X to Grade XII.

2. Comparison of the Intelligence Test Data.

In order to compare the characteristics of the test data it was necessary to use several of the common statistics. The

Table I. Frequency Distributions of Intelligence Test Data

I.Q.'s	Laycock			Willis-Smith			Henmon-Nelson (A)			Henmon-Nelson (B)			Otis		
$X_B < X \leq X_E$	X	XI	XII	X	XI	XII	X	XI	XII	X	XI	XII	X	XI	XII
152.5 — 157.5			1												
147.5 — 152.5			0												
142.5 — 147.5			0			1				1	1				
137.5 — 142.5	2	2	2	3	1	2	1	1	2	0	0				
132.5 — 137.5	1	2	3	3	4	7	1	1	1	3	3	3	4	3	3
127.5 — 132.5	4	8	7	4	4	7	3	7	8	2	5	8	8	19	14
122.5 — 127.5	7	8	11	6	10	13	6	11	15	13	18	17	19	22	17
117.5 — 122.5	8	13	14	12	24	24	16	26	31	21	27	27	14	18	25
112.5 — 117.5	8	12	19	17	17	21	11	21	21	13	17	14	25	21	14
107.5 — 112.5	19	16	16	19	11	18	5	10	30	16	16	11	17	9	6
102.5 — 107.5	13	8	10	14	13	23	4	11	16	16	9	3	7	7	6
97.5 — 102.5	10	6	11	12	12	18	7	13	11	9	7	2	3	3	1
92.5 — 97.5	9	4	3	7	9	13	2	2	1	5	0	1	1	1	
87.5 — 92.5	7	7	6	8	4	1	0	0	1	2	1		1		
82.5 — 87.5	4	2		0			1	1							
77.5 — 82.5	2	1		1											
Totals, N=	94	89	103	106	109	148	57	57	137	101	104	86	99	103	86

mean and the standard deviation have been computed for each distribution and offer a means of discerning an upward shift in intelligence test scores from Grade X to Grade XII. In addition, the standard error of the mean gives one a measure of the degree to which the sample mean may deviate from the true mean.

The Chi-Square test of normality is used to estimate the degree to which a given distribution conforms to the normal distribution. In this case, the null hypothesis will state that the distribution investigated deviates from the normal distribution only through sampling fluctuations. Should this distribution be nearly normal, Chi-Square will approach zero and the probability that this distribution conforms to the normal distribution approaches 1. However, a large sample whose parent population is normally distributed usually has a probability of approximately .50.

With the Chi-Square, the levels of confidence at which the null hypothesis is rejected apply as they do in tests of the significance of the other statistics. Thus, at the .05 level the odds are 20 to 1 that a distribution will not follow the normal distribution. With a probability of .01, the odds are 100 to 1 that a distribution will not follow the normal distribution.

In all tables employing the Chi-Square test of normality values for only Grade X have been calculated and are considered to be reasonably indicative of Chi-Square values expected in Grades XI and XII.

Willis-Smith Intelligence Test

$X_B < X < X_E$	f_o	$X_E - 110.5$	$\frac{x}{\sigma_x}$	A	ΔA	f_c	$f_o - f_c$	$(f_o - f_c)^2$	$\frac{(f_o - f_c)^2}{f_c}$
142.5 — ∞	0			.5000	.0049	.52))1.55			
137.5 — 142.5	3	32.0	2.58	.4951	.0097	1.03)	1.45	2.1025	1.36
132.5 — 137.5	3	27.0	2.18	.4854	.0229	2.43	0.57	.3249	0.13
127.5 — 132.5	4	22.0	1.775	.4625	.0478	5.06	-1.06	1.1236	0.22
122.5 — 127.5	6	17.0	1.37	.4147	.0807	8.55	-2.55	6.5025	0.76
117.5 — 122.5	12	12.0	0.97	.3340	.1183	12.50	-0.50	0.2500	0.02
112.5 — 117.5	17	7.0	0.565	.2157	.1521	16.15	+0.85	0.7225	0.04
107.5 — 112.5	19	2.0	0.161	.0636	.1584	16.80	2.2	4.85	0.29
102.5 — 107.5	14	-3.0	-0.242	.0948	.1474	15.65	-1.65	2.7225	0.17
97.5 — 102.5	12	-8.0	-0.645	.2422	.1109	11.75	0.25	.0625	0.01
92.5 — 97.5	7	-13.0	-1.05	.3531	.0734	7.78	-0.78	.6084	0.08
87.5 — 92.5	8	-18.0	-1.45	.4265	.0421	4.46	3.54	12.5316	2.81
82.5 — 87.5	0	-23.0	-1.856	.4686	.0195	2.06	-2.06	4.2436	2.06
77.5 — 82.5	1	-28.0	-2.26	.4881	.0119	1.26	-0.26	0.0676	0.05
	106			.5000	1.0000	106.00			8.00

$\overline{X}$ = 110.52
σ_x = 12.4
$\sigma_{\overline{x}}$ = 1.2

χ^2 = 8.00
df = 12
P = 0.815

Table III. Comparison of Common Statistics of each Intelligence Test in each grade*

Test	Grade	N	$\bar{X}$	σ_x	$\sigma_{\bar{x}}$	χ^2	P
Laycock	X	94	107.77	13.28	1.37	6.10	0.91
	XI	89	112.25	13.35	1.43	—	—
	XII	103	113.84	12.37	1.20	—	—
Willis-Smith	X	106	110.52	12.42	1.20	8.00	0.82
	XI	109	112.60	11.55	1.10	—	—
	XII	148	112.97	11.75	0.93	—	—
Henmon-Nelson (A)	X	57	113.77	11.13	1.48	13.03	0.22
	XI	104	114.66	9.96	0.98	—	—
	XII	137	114.66	9.19	0.78	—	—
Henmon-Nelson (B)	X	101	113.32	10.61	1.06	9.71	0.47
	XI	104	116.44	9.53	0.93	—	—
	XII	86	119.07	7.91	0.86	—	—
Otis	X	99	117.17	9.14	0.91	5.93	0.46
	XI	103	119.61	8.78	0.86	—	—
	XII	86	120.35	7.77	0.84	—	—
American Council	X	55	86.55	15.63	0.21	24.77	0.03
	XI	103	99.95	13.51	0.13	—	—
	XII	139	103.67	19.68	1.68	—	—

*Units are in terms of I.Q.'s. The American Council Test uses raw score units.

The above table contains in summarized form the information of the preceding table. It can now be seen that not only does the lower limit of each intelligence test increase from grade to grade but the mean I.Q. from Grade X to Grade XII has a definite tendency to increase. Moreover, with the exception of the American Council Test, there appears a definite tendency for the scatter of I.Q.'s

about the mean to diminish. This shrinking of the standard deviation is likely to be significant since the Laycock, the Willis-Smith and the Henmon-Nelson (A) show an appreciable increase in size from Grade X to Grade XII. Further, application of the Chi-Square test for normality in each distribution definitely indicates that the Grade X I.Q.'s may be expected to approach a normal distribution.

The American Council does register a decided increase in its mean from Grade X to Grade XII. From this point, consistency of any trend in keeping with the other intelligence tests is lacking. The standard deviation in Grade XII is increased markedly over that in Grade X and Grade XI, while the Chi-Square test indicates that the Grade X scores may be expected to conform to a normal distribution 3 times in 100, thus discarding the null hypothesis at the .05 level but not at the .01 level.

On comparing the mean I.Q.'s in each grade separately there seems to be an apparent increase from test to test in the following order: Laycock, Willis-Smith, Henmon-Nelson (A), Henmon-Nelson (B) and Otis. Corresponding to the apparent increase in the mean, there is a decrease of the standard deviation.

Table IV. Comparison of Common Statistics of Academic Achievement. *

	Grade	N	$\bar{X}$	σ_x	$\sigma_{\bar{x}}$	χ^2	P
Academic Achievement	X	108	61.39	13.28	1.37	5.72	0.96
	XI	109	64.68	13.21	1.26	—	—
	XII	153	58.20	13.61	1.10	—	—

*Units: Percent.

Table IV incorporates a few interesting features of the nature of the distribution of averaged academic marks from grade to grade. The mean in Grade XII shows a drop from that in the preceding two grades although the scatter of scores about the mean remains about the same. The drop in value of the mean could, perhaps, be due to the difference between the Departmental Examinations in Grade XII and examinations set by the University High School in Grade X and Grade XI. This in itself, may not be the only reason but may well be the main factor for the decreased value of the mean. The information from Table IV seems to indicate the need for a more critical teacher evaluation of students' academic work in Grades X and XI.

The Chi-Square test for normality indicates that the distribution of averaged academic marks may be expected to approach a normal distribution.

3. Analysis of the Predictive Values of the Intelligence Tests Employed.

The scatter-diagrams used in the computation of the correlation coefficients are to be found in Appendix B and for purposes of illustration one correlation chart complete with computation of r is included in Appendix A.

For the tests of the significance of r's Table 49 in Garrett[1] was used. The null hypothesis in determining the significance of a computed r states that any computed r of a

randomly-drawn sample from a parent population in which the variable, intelligence, is normally distributed, deviates from zero due to sampling fluctuations. At the .05 level of confidence we may reject the null hypothesis and state with a certainty of 100 to 5 that the computed value of an r is not due to accidents of sampling.

Table 49 in Garrett obviates the necessity of computing a critical ratio and then referring to Fisher's t-table to determine the probability that an r would differ from zero due to sampling fluctuations.

Table V. Summary of r's Denoting the Relationship between Intelligence Tests and Academic Achievement.

Test	Grade	N	r	σ_r	Significance
Laycock	X	94	0.45	0.08	Sig. at 0.01 level
	XI	89	0.52	0.08	Sig. at 0.01 level
	XII	103	0.40	0.08	Sig. at 0.01 level
Willis-Smith	X	106	0.64	0.06	Highly sig. at 0.01 level
	XI	109	0.53	0.07	Sig. at 0.01 level
	XII	148	0.57	0.06	Sig. at 0.01 level
Henmon-Nelson (A)	X	57	0.29	0.12	Sig. at 0.05 level
	XI	104	0.42	0.08	Sig. at 0.01 level
	XII	137	0.41	0.07	Sig. at 0.01 level
Henmon-Nelson (B)	X	101	0.55	0.07	Sig. at 0.01 level
	XI	104	0.53	0.07	Sig. at 0.01 level
	XII	86	0.46	0.09	Sig. at 0.01 level
Otis	X	99	0.63	0.06	Highly sig. at 0.01 level
	XI	103	0.54	0.07	Sig. at 0.01 level
	XII	86	0.50	0.08	Sig. at 0.01 level
American Council	X	55	0.54	0.10	Sig. at 0.01 level
	XI	103	0.42	0.08	Sig. at 0.01 level
	XII	139	0.51	0.06	Sig. at 0.01 level

Table $\overline{V}$ yields at a glance the information that the relationship between each of the intelligence tests and academic achievement as indicated by the respective r's is significant at the .05 level of confidence and, with the exception of the Henmon-Nelson (A) in Grade $\underline{X}$, is significant at the .01 level. This means that the null hypothesis may be rejected at the .01 level of confidence for all r's but the Grade $\underline{X}$ Henmon-Nelson (A) vs. academic achievement r.

In testing the significance of the difference between two r's, the assumption is made that these are random samples drawn from a parent population in which the variable, intelligence, is normally distributed. The null hypothesis states that any difference existing between two r's is the result of sampling fluctuations. At the .05 level, it may be said with a confidence of 20 to 1 that the difference is the result of something other than sampling fluctuations. At the .01 level, it may be said with a confidence of 100 to 1 that the difference is the result of something other than sampling fluctuations.

Here Fisher's z-function was used to replace the r-values since [2]

$$z = \frac{1}{2} \log \frac{1+r}{1-r}$$

is a nearly normally distributed function while r-values in a sampling distribution are not normally distributed. The actual formula that yields a critical ratio in terms of the z-function is: [3]

$$\frac{z_1 - z_2}{\sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}}$$

where $\sigma_{z_1 - z_2} = \sqrt{\frac{1}{N_1 - 3} + \frac{1}{N_2 - 3}}$

Tables VI, VII, and VIII do not indicate any significant difference between r's of any one test in relation to achievement between grades. This means that any difference of r noted for any intelligence test from Grade X to Grade XII may be ascribed to sampling fluctuations.

Table VI. Comparison of the Difference in Predictive Value of Intelligence Tests between Grades X and XI.

Test	r_{X}	r_{XI}	$z_X - z_{XI}$	C.R.	Significance of $r_X - r_{XI}$
Laycock	0.45	0.52	0.10	0.67	Not significant
Willis-Smith	0.64	0.53	0.17	1.21	
Henmon-Nelson (A)	0.29	0.42	0.15	0.88	
Henmon-Nelson (B)	0.55	0.53	0.03	0.20	
Otis	0.63	0.54	0.14	1.00	
American Council	0.54	0.42	0.15	0.88	

Table VII. Comparison of the Difference in Predictive Value of Intelligence Tests between Grades X and XII.

Test	r_{X}	r_{XII}	$z_X - z_{XII}$	C.R.	Significance of $r_X - r_{XII}$
Laycock	0.45	0.40	0.06	0.43	Not significant
Willis-Smith	0.64	0.57	0.11	0.85	
Henmon-Nelson (A)	0.29	0.41	0.14	0.88	
Henmon-Nelson (B)	0.55	0.46	0.12	0.80	
Otis	0.63	0.50	0.19	1.27	
American Council	0.54	0.51	0.04	0.25	

Table VIII. Comparison of the Difference in Predictive Value of Intelligence Tests between Grades XI and XII.

Test	r_{XI}	r_{XII}	$z_{XI} - z_{XII}$	C.R.	Significance of $r_{XI} - r_{XII}$
Laycock	0.52	0.40	0.16	1.07	Not significant
Willis-Smith	0.53	0.57	0.06	0.46	
Henmon-Nelson (A)	0.42	0.41	0.01	0.08	
Henmon-Nelson (B)	0.53	0.46	0.09	0.60	
Otis	0.54	0.50	0.05	0.33	
American Council	0.42	0.51	0.11	0.85	

Table IX. Comparison of the Difference in Predictive Value of Intelligence Tests in Grade X.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Laycock vs. Willis-Smith	.45	.64	.28	1.96	Significant at 0.05 level
Laycock vs. Henmon-Nelson (A)	.45	.29	.18	1.06	not significant
Laycock vs. Henmon-Nelson (B)	.45	.55	.14	.93	not significant
Laycock vs. Otis	.45	.63	.26	(1.74*	almost significant
				(2.86	highly sig. by use of Pearson-Filon Formula
Laycock vs. A. C. E.	.45	.54	.12	.71	almost significant
Willis-Smith vs. Henmon-Nelson (A)	.64	.29	.46	2.70	Significant at .01 level
Willis-Smith vs. Henmon-Nelson (B)	.64	.55	.14	1.00	not significant
Willis-Smith vs. Otis	.64	.62	.02	.14	not significant
Willis-Smith vs. A. C. E.	.64	.54	.16	.94	not significant
Henmon-Nelson (A) vs. Henmon-Nelson (B)	.29	.55	.32	(2.89	highly sig. by Pearson-Filon Formula
				(1.88*	almost significant
Henmon-Nelson (A) vs. Otis	.29	.63	.44	2.59	Significant at .01 level
Henmon-Nelson (A) vs. A. C. E.	.29	.54	.30	(1.58*	almost significant
				(2.08	Significant at .05 level
Henmon-Nelson (B) vs. Otis	.55	.63	.12	.85	not significant
Henmon-Nelson (B) vs. A. C. E.	.55	.54	.02	.14	not significant
Otis vs. A. C. E.	.63	.54	.14	.82	not significant

The .05 level of confidence was taken as being indicative of a significant difference between two r's.

Intelligence Tests in Grade XI.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Laycock vs. Willis-Smith	0.52	0.53	0.01	0.07	Not significant
Laycock vs. Henmon-Nelson (A)	0.52	0.42	0.13	0.88	Not significant
Laycock vs. Henmon-Nelson (B)	0.52	0.53	0.01	0.07	Not significant
Laycock vs. Otis	0.52	0.54	0.02	0.14	Not significant
Laycock vs. A. C. E.	0.52	0.42	0.13	0.87	Not significant
Willis-Smith vs. Henmon-Nelson (A)	0.53	0.42	0.14	1.00	Not significant
Willis-Smith vs. Henmon-Nelson (B)	0.53	0.53	0	0	Not significant
Willis-Smith vs. Otis	0.53	0.54	0.01	0.07	Not significant
Willis-Smith vs. A. C. E.	0.53	0.42	0.14	0.82	Not significant
Henmon-Nelson (A) vs. Henmon-Nelson (B)	0.42	0.53	0.14	1.00	Not significant
Henmon-Nelson (A) vs. Otis	0.42	0.54	0.15	1.07	Not significant
Henmon-Nelson (A) vs. A. C. E.	0.42	0.42	0	0	Not significant
Henmon-Nelson (B) vs. Otis	0.53	0.54	0.01	0.07	Not significant
Henmon-Nelson (B) vs. A. C. E.	0.53	0.42	0.14	1.00	Not significant
Otis vs. A. C. E.	0.54	0.42	0.15	1.07	Not significant

Use of Fisher's z-function here shows that in no test of the significance of differences between r's in Grade XI is there a CR which may be said to approach the .05 level of confidence. Hence, without the application of the Pearson-Filon formula we may be confident that there are no significant differences between r's of the intelligence tests vs. Academic Achievement in Grade XI.

Table XI. Comparison of the Difference in Predictive Values of Intelligence Tests in Grade XII.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Laycock vs. Willis-Smith	0.40	0.57	0.23	1.77*	not significant
Laycock vs. Willis-Smith	0.40	0.57		2.43	sig. at .05 by Pearson-Filon Formula
Laycock vs. Henmon-Nelson (A)	0.40	0.41	0.01	0.08	not significant
Laycock vs. Henmon-Nelson (B)	0.40	0.46	0.08	0.53	not significant
Laycock vs. Otis	0.40	0.50	0.13	0.87	not significant
Laycock vs. A. C. E.	0.40	0.51	0.14	1.08	not significant
Willis-Smith vs. Henmon-Nelson (A)	0.53	0.41	0.13	1.09	not significant
Willis-Smith vs. Henmon-Nelson (B)	0.53	0.46	0.09	0.64	not significant
Willis-Smith vs. Otis	0.53	0.50	0.04	0.29	not significant
Willis-Smith vs. A. C. E.	0.53	0.51	0.03	0.25	not significant
Henmon-Nelson (A) vs. Henmon-Nelson (B)	0.41	0.46	0.06	0.43	not significant
Henmon-Nelson (A) vs. Otis	0.41	0.50	0.11	0.69	not significant
Henmon-Nelson (A) vs. A. C. E.	0.41	0.51	0.12	1.00	not significant
Henmon-Nelson (B) vs. Otis	0.46	0.50	0.05	0.31	not significant
Henmon-Nelson (B) vs. A. C. E.	0.46	0.51	0.06	0.43	not significant
Otis vs. A. C. E.	0.50	0.51	0.01	0.07	not significant

The assumptions and null hypothesis used in interpreting these data are the same as those outlined on P. 22. However, in Tables IX to XI the r's themselves are dependent. Hence, the technique explained in Chapter III, Pp. 11, 12 was used in an attempt to obtain more valid results.

Only in Grade $\underline{\overline{X}}$ are there any significant differences between r's. With this sample of Grade X students the Willis-Smith and the Otis show superiority over the Laycock and the Henmon-Nelson (A).

4. Conclusions regarding the Comparative Predictive Values of the Intelligence Tests.

(1) In this study no one intelligence test has proven itself superior in predicting academic achievement throughout the high school grades.

(2) The differences in the predictive values of these intelligence tests are greatest in Grade $\underline{\overline{X}}$ where the Willis-Smith and the Otis are significantly superior to the Henmon-Nelson (A) and the Laycock.

(3) The Grade $\underline{\overline{X}}$ Henmon-Nelson (A) is distinctly inferior in this study to all tests save the Laycock.

(4) The Willis-Smith shows marked superiority to the Laycock in Grade $\underline{\overline{XII}}$.

(5) The American Council and the Henmon-Nelson (B) are significantly different only from the Grade $\underline{\overline{X}}$ Henmon-Nelson (A).

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Chapter V. Comparison of Reading Tests

1. The Nature of the Distribution of the Reading Tests.

Unlike the intelligence tests, the units of measurement in these tests are not the same in each test. For this reason the actual grouped frequency distributions were not presented. The essential information regarding each test from one grade level to another is presented in Table XII.

Table XII. Comparison of Common Statistics of the Reading Tests.

Test	Grade	N	$\bar{X}$	σ_x	$\sigma_{\bar{x}}$	χ^2	P
Nelson-Denny	X	108	60.19	16.97	1.63	14.31	0.08
	XI	110	77.82	21.34	2.02	—	—
	XII	151	90.73	24.18	1.97	—	—
Government (V)	X	107	37.57	11.20	1.08	4.83	0.77
	XI	110	45.23	9.59	0.92	—	—
	XII	153	49.51	10.45	0.85	—	—
Government (R)	X	108	384.26	91.75	8.80	125.02	(<0.01)
	XI	110	399.10	95.40	9.10	—	—
	XII	151	438.0	90.15	7.35	—	—
Government (C)	X	107	71.33	24.57	2.28	very large	(<0.01)
	XI	109	79.54	27.84	2.72	—	—
	XII	148	95.13	32.27	2.66	—	—
Government (A)	X	108	60.46	12.39	1.20	10.23	0.43
	XI	109	62.29	13.13	1.25	—	—
	XII	150	68.03	13.70	1.12	—	—

The means of each test show a definite increase from Grade X to Grade XII, which supports the expectation that reading

achievement increases during the student's high school years. The difference in units of measurement makes it impossible to compare roughly the increase between tests. There is no general agreement from test to test about an increase or a decrease in the scatter of scores from Grade X to Grade XII. Instead, the Nelson-Denny, the Govt. (C) and Govt. (A) show an increase in their standard deviations while Govt. (V) and Govt. (R) show no trend in either directions.

With only two exceptions the Chi-Square test for normality shows that these reading test results tend to conform to a normal distribution.

2. Analysis of the Predictive Values of the Reading Tests.

Table XIII. Summary of the r's Denoting Relationship between the Reading Tests and Academic Achievement

Grade	Test	N	Pearson's r	σ_r	Significance
X	Nelson-Denny	108	0.55	0.07	Significant at 0.01 level
	Govt. (V)	107	0.46	0.08	Significant at 0.01 level
	Govt. (R)	108	0.306	0.088	Significant at 0.01 level
	Govt. (C)	107	0.446	0.077	Significant at 0.01 level
	Govt. (A)	108	0.343	0.085	Significant at 0.01 level
XI	Nelson-Denny	110	0.40	0.08	Significant at 0.01 level
	Govt. (V)	110	0.335	0.085	Significant at 0.01 level
	Govt. (R)	110	0.355	0.084	Significant at 0.01 level
	Govt. (C)	109	0.353	0.084	Significant at 0.01 level
	Govt. (A)	109	0.249	0.09	Significant at 0.05 level
XII	Nelson-Denny	151	0.475	0.063	Highly significant at 0.01
	Govt. (V)	153	0.378	0.069	Significant at 0.01 level
	Govt. (R)	151	0.225	0.078	Significant at 0.01 level
	Govt. (C)	148	0.349	0.072	Significant at 0.01 level
	Govt. (A)	150	0.369	0.071	Significant at 0.01 level

The null hypothesis, that a computed r differs in value from zero only due to sampling fluctuations, can with a confidence of 100 to 1 be rejected for all r's computed here except one. The Grade XI Govt. (A) gives an r which allows us to reject the null hypothesis at the .05 level. Therefore, it is reasonable to state that each relationship expressed between a reading test and academic achievement in Table XIII is real.

Table XIV. Comparison of the Difference of the Predictive Value of Reading Tests between Grade X and Grade XI.

Test	r_{X}	r_{XI}	$z_X - z_{XI}$	CR	Significance of $r_X - r_{XI}$
Nelson-Denny	0.55	0.40	0.20	1.43)	
Govt. (V)	0.46	0.34	0.15	1.07)	
Govt. (R)	0.31	0.36	0.06	0.43)	not significant
Govt. (C)	0.45	0.35	0.11	0.79)	
Govt. (A)	0.34	0.25	0.09	0.64)	

Table XV. Comparison of the Difference of the Predictive Value of Reading Tests between Grade X and Grade XII.

Test	r_{X}	r_{XII}	$z_X - z_{XII}$	CR	Significance of $r_X - r_{XII}$
Nelson-Denny	0.55	0.48	0.10	0.77)	
Govt. (V)	0.46	0.38	0.10	0.77)	
Govt. (R)	0.31	0.23	0.09	0.69)	not significant
Govt. (C)	0.45	0.35	0.11	0.85)	
Govt. (A)	0.34	0.37	0.04	0.31)	

Table XVI. Comparison of the Difference of the Predictive Value of Reading Tests between Grade XI and Grade XII.

Test	r_{XI}	r_{XII}	$z_{XI} - z_{XII}$	CR	Significance of $r_{XI} - r_{XII}$
Nelson-Denny	0.40	0.48	0.10	0.77)	
Govt. (V)	0.34	0.38	0.05	0.38)	
Govt. (R)	0.36	0.23	0.15	1.15)	not significant
Govt. (C)	0.35	0.35	0	0)	
Govt. (A)	0.25	0.37	0.13	1.00)	

These tests of significance of the differences between r's between grades indicate that any difference between the r's of any one test may be attributed to sampling fluctuations.

Table XVII. Comparison of the Difference of the Predictive Value of Reading Tests in Grade X.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Nelson-Denny vs. Govt. (V)	0.55	0.46	0.12	0.86	not significant
Nelson-Denny vs. Govt. (R)	0.55	0.31	0.30	2.14	significant at 0.05
Nelson-Denny vs. Govt. (C)	0.55	0.45	0.14	1.00	not significant
Nelson-Denny vs. Govt. (A)	0.55	0.34	0.27	1.93*	nearly sig. at 0.05
				2.10	sig. by Formula
Govt. (V) vs. Govt. (R)	0.46	0.31	0.18	1.29	not significant
Govt. (V) vs. Govt. (C)	0.46	0.45	0.01	0.07	not significant
Govt. (V) vs. Govt. (A)	0.46	0.34	0.15	1.07	not significant
Govt. (R) vs. Govt. (C)	0.31	0.45	0.16	1.14	not significant
Govt. (R) vs. Govt. (A)	0.31	0.34	0.03	0.21	not significant
Govt. (C) vs. Govt. (A)	0.45	0.34	0.13	0.93	not significant

Table XVIII. Comparison of the Differences of the Predictive Value of Reading Tests in Grade XI.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Nelson-Denny vs. Govt. (V)	0.40	0.34	0.07	0.50	not significant
Nelson-Denny vs. Govt. (R)	0.40	0.36	0.04	0.29	not significant
Nelson-Denny vs. Govt. (C)	0.40	0.35	0.05	0.36	not significant
Nelson-Denny vs. Govt. (A)	0.40	0.25	0.16	1.14	not significant
Govt. (V) vs. Govt. (R)	0.34	0.35	0.02	0.14	not significant
Govt. (V) vs. Govt. (C)	0.34	0.35	0.02	0.14	not significant
Govt. (V) vs. Govt. (A)	0.34	0.25	0.09	0.64	not significant
Govt. (R) vs. Govt. (C)	0.35	0.35	0	0	not significant
Govt. (R) vs. Govt. (A)	0.35	0.25	0.11	0.79	not significant
Govt. (C) vs. Govt. (A)	0.35	0.25	0.11	0.79	not significant

Table XIX. Comparison of the Differences of the Predictive Value of Reading Tests in Grade XII.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Nelson-Denny vs. Govt. (V)	0.48	0.38	0.12	1.00	not significant
Nelson-Denny vs. Govt. (R)	0.48	0.23	0.29	2.42	significant at 0.05
Nelson-Denny vs. Govt. (C)	0.48	0.35	0.15	1.25	not significant
Nelson-Denny vs. Govt. (A)	0.48	0.37	0.13	1.08	not significant
Govt. (V) vs. Govt. (R)	0.38	0.23	0.17	1.42	not significant
Govt. (V) vs. Govt. (C)	0.38	0.35	0.03	0.25	not significant
Govt. (V) vs. Govt. (A)	0.38	0.37	0.01	0.08	not significant
Govt. (R) vs. Govt. (C)	0.23	0.35	0.14	1.17	not significant
Govt. (R) vs. Govt. (A)	0.23	0.37	0.16	1.33	not significant
Govt. (C) vs. Govt. (A)	0.35	0.37	0.02	0.17	not significant

Use of the Pearson-Filon formula is warranted in the above tables in only one instance where it can be expected that the CR will be raised above the .05 level of confidence. In Grade X, the null hypothesis regarding the significance of differences between r's may be rejected in the comparison of the Nelson-Denny with Govt. (R). In Grade XI no rejection of the null hypothesis is called for, while in Grade XII a significant difference is again noted between the Nelson-Denny and Govt. (R).

3. Conclusions regarding the Predictive Values of the Reading Tests.

(1) There is no conclusive evidence that any one reading test predicts academic achievement better than any other reading test in this study. However, the Nelson-Denny shows definite superiority over Govt. (R) in Grade X and Grade XII but not in Grade XI.

Table XX. Comparison of the Values of Reading Tests and Intelligence Tests in Predicting Academic Achievement in Grade X

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Nelson-Denny vs. Laycock	0.55	0.45	0.14	1.00	not significant
Nelson-Denny vs. Willis-Smith	0.55	0.64	0.14	1.00	not significant
Nelson-Denny vs. Henmon-Nelson (A)	0.55	0.29	0.32	1.88*	almost significant at 0.05
Nelson-Denny vs. Henmon-Nelson (B)	0.55	0.55	0	0	not significant
Nelson-Denny vs. Otis	0.55	0.63	0.12	0.86	not significant
Nelson-Denny vs. A. C. E.	0.55	0.54	0.02	0.18	not significant
Govt. (V) vs. Laycock	0.46	0.45	0.02	0.14	not significant
Govt. (V) vs. Willis-Smith	0.46	0.64	0.26	1.86*	almost significant at 0.05
Govt. (V) vs. Henmon-Nelson (A)	0.46	0.29	0.20	1.18	not significant
Govt. (V) vs. Henmon-Nelson (B)	0.46	0.55	0.12	0.86	not significant
Govt. (V) vs. Otis	0.46	0.63	0.24	1.72*	almost significant at 0.05
Govt. (V) vs. A. C. E.	0.46	0.54	0.14	0.82	not significant
Govt. (R) vs. Laycock	0.31	0.45	0.16	1.14	not significant
Govt. (R) vs. Willis-Smith	0.31	0.64	0.44	3.14	significant at 0.01
Govt. (R) vs. Henmon-Nelson (A)	0.31	0.29	0.02	0.12	not significant
Govt. (R) vs. Henmon-Nelson (B)	0.31	0.55	0.30	2.14	significant at 0.05
Govt. (R) vs. Otis	0.31	0.63	0.42	3.00	significant at 0.01
Govt. (R) vs. A. C. E.	0.31	0.54	0.28	1.65*	almost significant at 0.05
Govt. (C) vs. Laycock	0.45	0.45	0	0	not significant
Govt. (C) vs. Willis-Smith	0.45	0.64	0.28	2.00	significant at 0.05
Govt. (C) vs. Henmon-Nelson (A)	0.45	0.29	0.18	1.06	not significant
Govt. (C) vs. Henmon-Nelson (B)	0.45	0.55	0.14	1.00	not significant
Govt. (C) vs. Otis	0.45	0.63	0.26	1.86*	nearly significant at 0.05
Govt. (C) vs. A. C. E.	0.45	0.54	0.12	0.71	not significant
Govt. (A) vs. Laycock	0.34	0.45	0.13	0.87	not significant
Govt. (A) vs. Willis-Smith	0.34	0.64	0.41	2.93	significant at 0.01
Govt. (A) vs. Henmon-Nelson (A)	0.34	0.29	0.05	0.36	not significant
Govt. (A) vs. Henmon-Nelson (B)	0.34	0.55	0.27	1.93*	almost significant at 0.05
Govt. (A) vs. Otis	0.34	0.63	0.39	2.79	significant at 0.01
Govt. (A) vs. A. C. E.	0.34	0.54	0.25	1.78*	almost significant at 0.05

Predicting Academic Achievement in Grade XI.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Nelson-Denny vs. Laycock	0.40	0.52	0.16	1.14	not significant
Nelson-Denny vs. Willis-Smith	0.40	0.53	0.17	1.21	not significant
Nelson-Denny vs. Henmon-Nelson (A)	0.40	0.42	0.03	0.21	not significant
Nelson-Denny vs. Henmon-Nelson (B)	0.40	0.53	0.17	1.21	not significant
Nelson-Denny vs. Otis	0.40	0.54	0.18	1.29	not significant
Nelson-Denny vs. A. C. E.	0.40	0.42	0.03	0.21	not significant
Govt. (V) vs. Laycock	0.34	0.52	0.23	1.64*	not significant
Govt. (V) vs. Willis-Smith	0.34	0.53	0.24	1.72*	nearly significant at 0.05
Govt. (V) vs. Henmon-Nelson (A)	0.34	0.42	0.10	0.72	not significant
Govt. (V) vs. Henmon-Nelson (B)	0.34	0.53	0.24	1.72*	nearly significant at 0.05
Govt. (V) vs. Otis	0.34	0.54	0.25	1.79*	nearly significant at 0.05
Govt. (V) vs. A. C. E.	0.34	0.42	0.10	0.72	not significant
Govt. (R) vs. Laycock	0.35	0.52	0.21	1.50	not significant
Govt. (R) vs. Willis-Smith	0.35	0.53	0.22	1.57*	almost significant
Govt. (R) vs. Henmon-Nelson (A)	0.35	0.42	0.08	0.57	not significant
Govt. (R) vs. Henmon-Nelson (B)	0.35	0.53	0.22	1.57*	almost significant
Govt. (R) vs. Otis	0.35	0.54	0.23	1.64*	almost significant at 0.05
Govt. (R) vs. A. C. E.	0.35	0.42	0.08	0.57	not significant
Govt. (C) vs. Laycock	0.35	0.52	0.21	1.50	not significant
Govt. (C) vs. Willis-Smith	0.35	0.53	0.22	1.57*	almost significant
Govt. (C) vs. Henmon-Nelson (A)	0.35	0.42	0.08	0.57	not significant
Govt. (C) vs. Henmon-Nelson (B)	0.35	0.53	0.22	1.57*	almost significant
Govt. (C) vs. Otis	0.35	0.54	0.23	1.64*	almost significant at 0.05
Govt. (C) vs. A. C. E.	0.35	0.42	0.08	0.57	not significant
Govt. (A) vs. Laycock	0.25	0.52	0.32	2.29	significant at 0.05
Govt. (A) vs. Willis-Smith	0.25	0.53	0.33	2.36	significant at 0.05
Govt. (A) vs. Henmon-Nelson (A)	0.25	0.42	0.19	1.36	not significant
Govt. (A) vs. Henmon-Nelson (B)	0.25	0.53	0.33	2.36	significant at 0.05
Govt. (A) vs. Otis	0.25	0.54	0.34	2.43	significant at 0.05
Govt. (A) vs. A. C. E.	0.25	0.42	0.19	1.36	not significant

Predicting Academic Achievement in Grade XII.

Tests Compared	r_1	r_2	$z_1 - z_2$	CR	Significance of $r_1 - r_2$
Nelson-Denny vs. Laycock	0.48	0.40	0.10	0.77	not significant
Nelson-Denny vs. Willis-Smith	0.48	0.57	0.13	1.08	not significant
Nelson-Denny vs. Henmon-Nelson (A)	0.48	0.41	0.08	0.67	not significant
Nelson-Denny vs. Henmon-Nelson (B)	0.48	0.46	0.02	0.14	not significant
Nelson-Denny vs. Otis	0.48	0.50	0.03	0.21	not significant
Nelson-Denny vs. A. C. E.	0.48	0.51	0.04	0.33	not significant
Govt. (V) vs. Laycock	0.38	0.40	0.02	0.15	not significant
Govt. (V) vs. Willis-Smith	0.38	0.57	0.25	2.08	significant at 0.05
Govt. (V) vs. Henmon-Nelson (A)	0.38	0.41	0.04	0.33	not significant
Govt. (V) vs. Henmon-Nelson (B)	0.38	0.46	0.10	0.71	not significant
Govt. (V) vs. Otis	0.38	0.60	0.15	1.07	not significant
Govt. (V) vs. A. C. E.	0.38	0.51	0.16	1.33	not significant
Govt. (R) vs. Laycock	0.23	0.40	0.19	1.46	not significant
Govt. (R) vs. Willis-Smith	0.23	0.57	0.42	3.50	significant at 0.01
Govt. (R) vs. Henmon-Nelson (A)	0.23	0.41	0.21	1.75*	almost significant at 0.05
Govt. (R) vs. Henmon-Nelson (B)	0.23	0.46	0.27	1.93*	almost significant at 0.05
Govt. (R) vs. Otis	0.23	0.50	0.32	2.28	significant at 0.05
Govt. (R) vs. A. C. E.	0.23	0.51	0.33	2.75	significant at 0.01
Govt. (C) vs. Laycock	0.35	0.40	0.05	0.39	not significant
Govt. (C) vs. Willis-Smith	0.35	0.57	0.28	2.34	almost significant at 0.01
Govt. (C) vs. Henmon-Nelson (A)	0.35	0.41	0.07	0.58	not significant
Govt. (C) vs. Henmon-Nelson (B)	0.35	0.46	0.13	0.93	not significant
Govt. (C) vs. Otis	0.35	0.50	0.18	1.29	not significant
Govt. (C) vs. A. C. E.	0.35	0.51	0.19	1.58	not significant
Govt. (A) vs. Laycock	0.37	0.40	0.03	0.23	not significant
Govt. (A) vs. Willis-Smith	0.37	0.57	0.24	2.00	significant at 0.01
Govt. (A) vs. Henmon-Nelson (A)	0.37	0.41	0.05	0.42	not significant
Govt. (A) vs. Henmon-Nelson (B)	0.37	0.46	0.11	0.79	not significant
Govt. (A) vs. Otis	0.37	0.50	0.16	1.14	not significant
Govt. (A) vs. A. C. E.	0.37	0.51	0.17	1.42	not significant

2. Conclusions regarding the Predictive Value of Reading Tests Compared to the Predictive Value of Intelligence Tests.

(1) All of the Reading Tests predict academic achievement equally as well as the Henmon-Nelson (A) and the Laycock at all grade levels.

(2) The Nelson-Denny is the only reading test that predicts academic achievement equally as well as each of the intelligence tests.

(3) There is strong evidence to support the view that the Government Reading Tests fail to predict academic achievement equally as well as the Willis-Smith, the Henmon-Nelson (B), the Otis and the American Council.

Chapter VII. Comparison of the Reading Tests in Predicting English Achievement.

1. Nature of the Distributions of English Achievement Data.

Table XXIII. English Achievement Frequency Distributions.

Percentage $X_B < X \leq X_E$	Grade X f_1	Grade XI f_2	Grade XII f_3
92.5 — 97.5		3	2
87.5 — 92.5	1	4	3
82.5 — 87.5	4	3	2
77.5 — 82.5	7	14	16
72.5 — 77.5	16	6	15
67.5 — 72.5	11	14	21
62.5 — 67.5	16	18	20
57.5 — 62.5	16	19	14
52.5 — 57.5	12	12	19
47.5 — 52.5	14	9	10
42.5 — 47.5	3	1	8
37.5 — 42.5	4	6	9
32.5 — 37.5	4	3	4
27.5 — 32.5	2	1	1
TOTAL, N -	110	113	144

From Table XXIII it is evident that there were approximately an equal number of poor English students in each grade. Hence, it seems that there is little or no elimination of English students as they advance through the high school.

Table XXIV. Comparison of Common Statistics of English Achievement Distributions.

Grade	N	$\bar{X}$	σ_x	$\sigma_{\bar{x}}$	χ^2	P
X	110	61.95	13.20	1.26	13.41	0.27
XI	113	64.51	14.03	1.33	—	—
XII	153	63.01	11.36	0.95	—	—

In English Achievement from Grade X to Grade XII there is no distinctive change in the value of the arithmetic mean. Unlike academic achievement, there is no apparent drop in the value of the mean score from Grade X and Grade XI to Grade XII. The scatter is not as great in Grade XII as in the previous two grades.

The Chi-Square test of normality in these distributions at each grade level shows that English Achievement may be expected to be distributed normally.

2. Analysis of the Value of the Reading Tests in Predicting English Achievement

Table XXV. Summary of r's Denoting the Relationship between the Reading Tests and English Achievement.

Grade	Test	N	Pearson's r	σ_r	Significance
X	Nelson-Denny	110	0.597	0.062	Highly significant at 0.01
	Govt. (V)	108	0.622	0.06	Highly significant at 0.01
	Govt. (R)	109	0.222	0.092	Significant at 0.05
	Govt. (C)	109	0.403	0.081	Significant at 0.01
	Govt. (A)	109	0.334	0.086	Significant at 0.01
XI	Nelson-Denny	113	0.653	0.054	Highly significant at 0.01
	Govt. (V)	112	0.526	0.069	Highly significant at 0.01
	Govt. (R)	113	0.34	0.084	Significant at 0.01
	Govt. (C)	114	0.483	0.072	Significant at 0.01
	Govt. (A)	109	0.41	0.08	Significant at 0.01
XII	Nelson-Denny	144	0.726	0.04	Highly significant at 0.01
	Govt. (V)	144	0.665	0.047	Highly significant at 0.01
	Govt. (R)	142	0.355	0.074	Significant at 0.01
	Govt. (C)	144	0.456	0.066	Significant at 0.01
	Govt. (A)	140	0.419	0.07	Significant at 0.01

The r found for each reading test at each grade level is in all cases highly significant of the indicated relationship between each reading test and English achievement. For every r obtained, but that of Grade X Government Reading (R) vs. English achievement, we may reject the null hypothesis and conclude with confidence (100 to 1 odds) that these r's do indicate some relationship between the reading tests and the criterion of their predictive value.

Table XXVI. Comparison of the Difference in Predictive Value of Reading Tests between Grades X and XI.

Test	r_{X}	r_{XI}	$z_{X} - z_{XI}$	CR	Significance of $r_{X} - r_{XI}$
Nelson-Denny	0.60	0.65	0.09	0.64)	
Govt. (V)	0.62	0.53	0.14	1.00)	
Govt. (R)	0.22	0.34	0.13	0.93)	not significant
Govt. (C)	0.40	0.48	0.10	0.72)	
Govt. (A)	0.33	0.41	0.10	0.72)	

Table XXVII. Comparison of the Difference in Predictive Value of Reading Tests between Grades X and XII

Test	r_{X}	r_{XII}	$z_{X} - z_{XII}$	CR	Significance of $r_{X} - r_{XII}$
Nelson-Denny	0.60	0.73	0.24	1.85)	
Govt. (V)	0.62	0.67	0.08	0.62)	
Govt. (R)	0.22	0.36	0.16	1.23)	not significant
Govt. (C)	0.40	0.46	0.08	0.62)	
Govt. (A)	0.33	0.42	0.11	0.85)	

Table XXVIII. Comparison of the Difference in Predictive Value of Reading Tests between Grades XI and XII

Test	r_{XI}	r_{XII}	$z_{XI} - z_{XII}$	CR	Significance of $r_{XI} - r_{XII}$
Nelson-Denny	0.65	0.73	0.15	1.15)	
Govt. (V)	0.53	0.67	0.22	1.69)	
Govt. (R)	0.34	0.36	0.03	0.23)	not significant
Govt. (C)	0.48	0.46	0.02	1.54)	
Govt. (A)	0.41	0.42	0.01	0.77)	

Fisher's z-function was used here with no need for using the Pearson-Filon formula since the samples are independent. Hence the same assumptions and procedures hold that were used in comparing the intelligence tests values for predicting academic achievement. The tests of the significance of the differences between r's between grades clearly shows that in no case can one conclude with confidence at the .05 level that any difference between r's between grades is not due to sampling fluctuations.

Table XXIX. Comparison of the Difference in Predictive Value of Reading Tests in Grade X.

ests Compared	r_1	r_2	z_1-z_2	CR	Significance of r_1-r_2
lson-Denny vs. Govt. (V)	0.60	0.62	0.04	0.29	not significant
lson-Denny vs. Govt. (R)	0.60	0.22	0.47	3.36	significant at 0.01
lson-Denny vs. Govt. (C)	0.60	0.40	0.27	1.93*	almost significant at .05
lson-Denny vs. Govt. (A)	0.60	0.33	0.35	2.50	almost significant at .01
vt. (V) vs. Govt. (R)	0.62	0.22	0.51	3.65	significant at 0.01
vt. (V) vs. Govt. (C)	0.62	0.40	0.31	2.22	Significant at 0.05
vt. (V) vs. Govt. (A)	0.62	0.33	0.39	2.78	Significant at 0.01
vt. (R) vs. Govt. (C)	0.22	0.40	0.20	1.43	not significant
vt. (R) vs. Govt. (A)	0.22	0.33	0.12	0.86	not significant
vt. (C) vs. Govt. (A)	0.40	0.33	0.08	0.57	not significant

Table XXX. Comparison of the Difference in Predictive Value of Reading Tests in Grade XI.

ests Compared	r_1	r_2	z_1-z_2	CR	Significance of $r_1 - r_2$
elson-Denny vs. Govt. (V)	0.65	0.52	0.20	1.43	not significant
elson-Denny vs. Govt. (R)	0.65	0.34	0.43	3.07	significant at 0.01
elson-Denny vs. Govt. (C)	0.65	0.48	0.26	1.72*	almost significant at .05
elson-Denny vs. Govt. (A)	0.65	0.41	0.34	2.43	almost significant at .01
ovt. (V) vs. Govt. (R)	0.52	0.34	0.23	1.64*	almost significant at .05
ovt. (V) vs. Govt. (C)	0.52	0.48	0.06	0.43	almost signifi cant at .05
ovt. (V) vs. Govt. (A)	0.52	0.41	0.14	1.00	almost significant at .05
ovt. (R) vs. Govt. (C)	0.34	0.48	0.17	1.22	not significant
ovt. (R) vs. Govt. (A)	0.34	0.41	0.09	0.64	not significant
ovt. (C) vs. Govt. (A)	0.48	0.41	0.08	0.57	not significant

Table XXXI. Comparison of the Difference in Predictive Value of Reading Tests in Grade XII.

ests Compared	r_1	r_2	z_1-z_2	CR	Significance of $r_1 - r_2$
elson-Denny vs. Govt. (V)	0.73	0.67	0.12	1.00	not significant
elson-Denny vs. Govt. (R)	0.73	0.36	0.55	4.58	significant at 0.01
elson-Denny vs. Govt. (C)	0.73	0.46	0.43	3.07	significant at 0.01
elson-Denny vs. Govt. (A)	0.73	0.42	0.48	3.43	significant at 0.01
ovt. (V) vs. Govt. (R)	0.67	0.36	0.43	3.07	significant at 0.01
ovt. (V) vs. Govt. (C)	0.67	0.46	0.31	2.22	significant at 0.05
ovt. (V) vs. Govt. (A)	0.67	0.42	0.36	2.57	significant at 0.01
ovt. (R) vs. Govt. (C)	0.36	0.46	0.12	0.86	not significant
ovt. (R) vs. Govt. (A)	0.36	0.42	0.07	0.50	not significant
ovt. (C) vs. Govt. (A)	0.46	0.42	0.05	0.36	not significant

Interpretation of these data follow along the lines predicated in Chapter IV, P.22 with the necessary modification in considering "almost" significant CR's as outlined in Chapter III, Pp. 11, 12.

It might be noted here that these reading tests have been designed primarily to predict English achievement. Whilst they all show a significant relationship with English achievement at each grade level, the consistent, significant difference between the Nelson-Denny, Government Reading (V) and the Government Reading (R), (C), (A) is unexpected.

3. Conclusions regarding the Predictive Values of the Reading Tests.

(1) The Nelson-Denny Reading Test is distinctly superior to the Government Reading Tests except Government Reading (V).

(2) There is no significant difference between the Nelson-Denny and Government Reading (V) in any grade.

(3) The Government Reading (V) is distinctly superior to the other Government Tests in Grades X and XII.

(4) There is no apparent difference in the predictive values of the Government Reading (R), (C), (A).

(5) The Nelson-Denny almost reaches a significant level in the difference between its predictive value in Grades X and in XII.

Chapter VIII. General Conclusions and Implications.

1. General Conclusions of this Study.

(1) Throughout the high school grades no particular intelligence test or reading achievement test has proven outstanding in predicting academic achievement. Nevertheless, each test at each grade level has indicated a significant or a highly significant relationship with academic achievement.

(2) In Grade $\underline{\overline{X}}$ there tend to be more significant differences between the relationships of the predictive tests with academic achievement than at any other grade level. All intelligence tests in Grade $\underline{\overline{X}}$ but the Laycock indicate significant superiority to the Henman-Nelson (A), while the Willis-Smith and the Otis are significantly superior to the Laycock in this grade. The Nelson-Denny is significantly superior to the Govt. (R) in Grade $\underline{\overline{X}}$.

(3) In Grade $\underline{\overline{XI}}$ no significant difference was indicated between any of the predictive tests in predicting academic achievement. However, the Government Reading Tests are almost significantly different from the Willis-Smith, the Henmon-Nelson (B), the Otis and the American Council Intelligence Test.

(4) In Grade $\underline{\overline{XII}}$ the Willis-Smith showed significant superiority over the Laycock and the Government Reading Tests. All of the

intelligence tests except the Laycock showed significant or almost significant superiority over Govt. (R) in predicting academic achievement.

(5) The Nelson-Denny and Govt. (V) are distinctly superior to Govt. (R), Govt. (C), Govt. (A) in predicting English achievement in Grades X and XII. The Nelson-Denny shows significant superiority to Govt. (R), Govt. (C), Govt. (A) at all grade levels.

(6) There is almost a significant difference in the value of the Nelson-Denny in predicting English achievement between Grades X and XII. All other tests in this study have consistently shown the same predictive value at each grade level.

2. Implications of the Study.

Intelligence tests and reading achievement tests may be relied upon to predict academic achievement in the high school with a reasonable degree of accuracy. Evidence does not show that any predictive test is consistently superior but it may be that the significant divergencies between predictive tests in Grade X are especially important. In this grade, more than in any other, students require educational guidance to indicate reliably their chances of success in certain high school subjects. Hence it would appear that the highly significant relationship of the Willis-Smith and of the Otis to academic achievement at this grade level outweighs their lack of superiority in Grades XI and

XII. Further, it may be inferred that more care in the selection of predictive tests is required in Grade X than in any other grade.

The Nelson-Denny Reading Test seems to predict academic achievement equally as well as the intelligence tests while the test of the reading rate of a student apparently has less predictive value for his academic or English achievement than any of the other tests. Taken as a whole, the Government Reading Tests do not reach the same standard as the standardized intelligence and reading tests do in their prediction of academic achievement and of English achievement.

APPENDIX A.

Sample Correlation Table to Illustrate the Method of Computing r's.

Willis – Smith Intell. Test, X_1 I.Q. pts.

X_2 →

Gr. $\overline{X}$ Academic Achiev^{t}, X_2 %

X_1 \ X_2	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	f_1	f_1U_1	$f_1U_1^2$	fU_1U_2
U_1 \ U_2	−7	−6	−5	−4	−3	−2	−1	0	1	2	3	4	5	6	7				
140 6												24	30		42	3	18	108	96
135 5								0					25			3	15	75	25
130 4										8	12			24		4	16	64	56
125 3										6	9	12		18		6	18	54	72
120 2							−2	0	2	4	6	8	10			12	24	48	70
115 1							−1	0	1	2	3					17	17	17	14
110 0			0	0		0	0	0	0	0	0			0		19	0	0	0
105 −1			5		3	2	1	0	−1	−2		−4				14	−14	14	6
100 −2		12		8	6	4	2	0	−2							12	−24	48	38
95 −3	21	18			9		3		−3							7	−21	63	66
90 −4		24	20	16	12	8	4			−8						8	−32	128	80
85 −5																0	0	0	0
80 −6									−6							1	−6	36	−6
f_2	1	3	4	4	7	5	12	16	16	13	9	6	5	4	1	106	11	655	517
f_2U_2	−7	−18	−20	−16	−21	−10	−12	0	16	26	27	24	25	24	7	45			
$f_2U_2^2$	49	108	100	64	63	20	12	0	16	52	81	96	125	144	49	979			
fU_1U_2	21	54	30	24	54	14	16	0	−13	14	60	56	85	60	42	517			

Computation:

1. $\overline{U_1U_2} = \frac{517}{106} = 4.8774$
2. $\overline{U_1} = \frac{11}{106} = 0.1038$
3. $\overline{U_1}^2 = (0.1038)^2 = 0.0108$
4. $\overline{U_2} = \frac{45}{106} = 0.4245$
5. $\overline{U_2}^2 = (0.4245)^2 = 0.1802$
6. $\overline{U_1^2} = \frac{655}{106} = 6.1792$
7. $\overline{U_2^2} = \frac{979}{106} = 9.2358$
8. $p_{U_1U_2} = 4.8328$
9. $\sigma_1 = \sqrt{6.1684}$
   $= 2.484$
10. $\sigma_2 = \sqrt{9.156}$
    $= 3.026$
11. $r = \frac{4.8328}{7.5166} = 0.64.$
12. $\sigma_r = \frac{0.5904}{\sqrt{105}} = 0.0576$

APPENDIX B.

Scatter-diagrams used to Calculate Each r.

Grade X Academic Achievement, Percent.

Laycock Intelligence Test, I.Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140												1	1		
135													1		
130							1		1		1	1			
125											2	1	1	2	1
120						2		1	1	2	2				
115				1	1				2	4					
110		1	2		1	1	1	4	1	2	2	2	2		
105		2	1		1		1	2	3	2	1				
100				1	1	2	1	2	2			1			
95							2	1	3	2	1				
90	1			1	1		2		1	1					
85				1			1	1	1						
80					1		1								
75															

Grade X Academic Achievement, Percent.

Willis - Smith Intelligence Test, I.Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140												1	1		1
135								2					1		
130										1	2			1	
125										1	2	1		2	
120							1	1	1	1	2	3	3		
115							1	8	3	3	2				
110			1	2		2	2	2	3	5	1			1	
105			2		1	1	2	1	5	1		1			
100		1		1	2	1	3	2	2						
95	1	1			3		1		1						
90		1	1	1	1	1	2			1					
85															
80									1						

Grade X Academic Achievement, Percent

Henmon - Nelson (A) Intelligence Test, I.Q pts.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140							1							
135														1
130				1							2			
125							2		1	2			1	
120	1	2			1	1		3	3	2	1	2		
115		1	1	1			2	2	1		2	1		
110				1	1	1			1			1		
105						1	1	2						
100				1		1		4	1					
95			1					1						
90														
85				1										

Hennmon – Nelson (B) Intelligence Test, I.Q. pts.

Grade X. Academic Achievement, Percent.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
145															1
140												1			
135												1	2		
130								1						1	
125							2	1	1	1	4	2	1	1	
120				1			2	8		3	2	2	1	2	
115		1			1				5	1	3	1	1		
110			2	2	2	1	2	2	3	2					
105	1	2		1	1	3	1	3	2	2					
100						1	3		4	1					
95	1		1				1		1	1					
90					2										
85															

Grade X Academic Achievement, Percent.

Otis Intelligence Test, I.Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
135												1	2	1	
130									1	1	1	2	1	1	1
125								6		2	7	1	2	1	
120						2	2	4	2	2	1	1			
115	1		1	3	1		2	3	7	5		1		1	
110		2		1	3	2	4	2	3						
105		1	1			1	2		2						
100					1	1			1						
95										1					
90	1														

Grade X Academic Achievement, Percent.

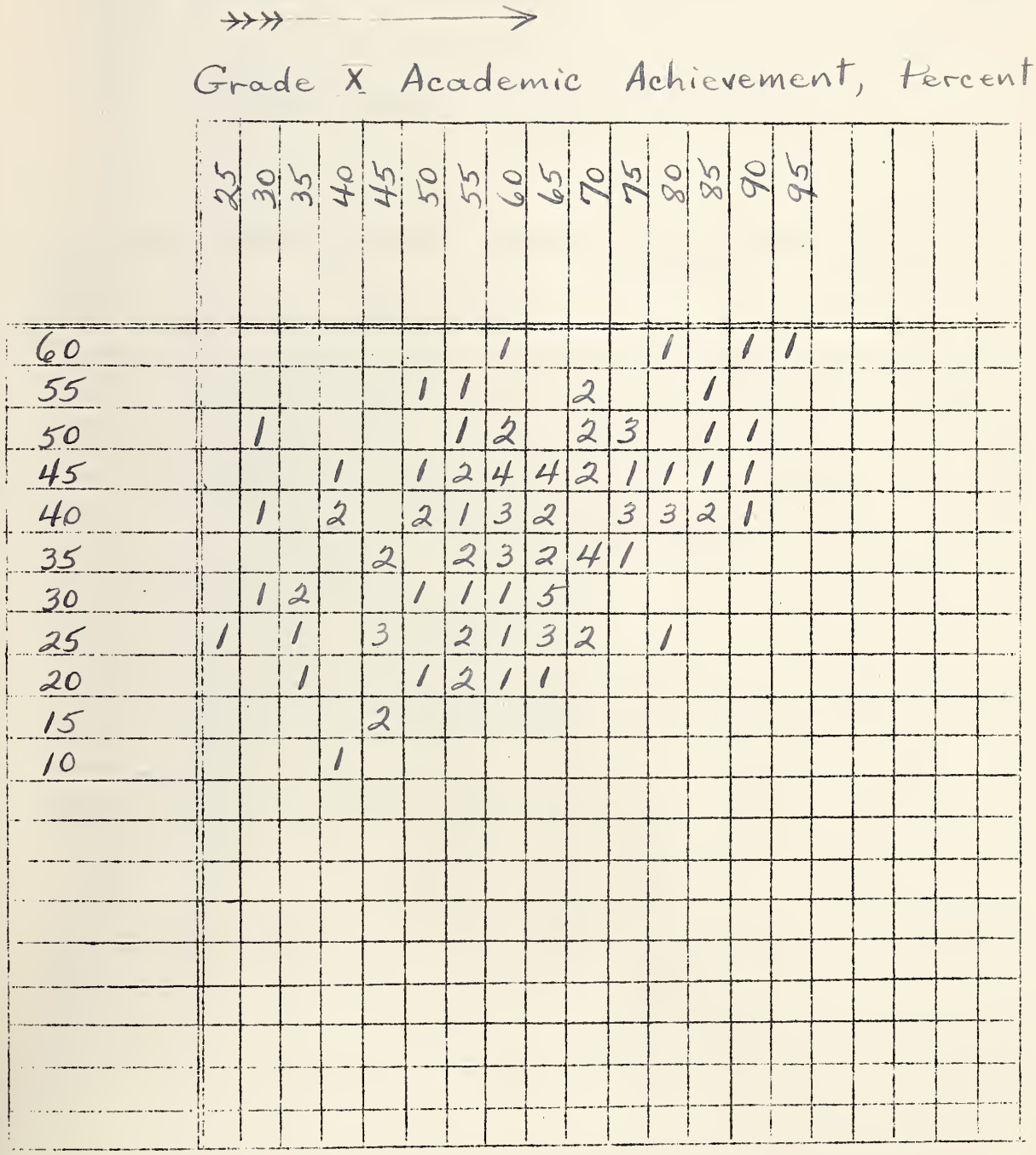
A.C.E. Intelligence Test, Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95						
130														1						
125																				
120											1									
115											1		1							
110											1									
105									1	1		1								
100							1	1												
95			1		1		2	2	1	2	1									
90					1			2	2	1		1								
85		2					1	3	1			1								
80																				
75		1		2		1	1	1	1											
70	1			2		1		2												
65				1		2	1		1		1									
60								1												

Grade X Academic Achievement, Percent.

Nelson - Denny Reading Test, Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
110													1		1
100										1	1		1	1	
90				1				1		1		2			
80						1	1	2	2	1	1	1		1	
70		1				1	3	5	2	2	3			1	
60					1	2	2	3	5	2	4	2	2	2	
50		1	3	1			2	3	6	2					
40	1	1	1	1	5	1	3	2	2	2		1			
30	1			1	1		1		1						
20						1									


Grade X Academic Achievement, Percent.
Govt. Reading Test (V), Raw scores.
25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
60 1 1 1 1
55 1 1 2 1
50 1 1 2 2 3 1 1
45 1 1 2 4 4 2 1 1 1 1
40 1 2 2 1 3 2 3 3 2 1
35 2 2 3 2 4 1
30 1 2 1 1 1 5
25 1 1 3 2 1 3 2 1
20 1 2 1 1
15 2
10 1

Grade X Academic Achievement, Percent.

Govt. Reading (R), Words per min.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
562.5				1				1		1	1	2	1		
537.5					1		1	1				1		1	
512.5						1			1		1		1	1	
487.5														1	
462.5					1			2	4	1	1		1		1
437.5		1		1		1	1		1		1				
412.5			2	1			2	2		3	2	1			
387.5									3	1		2	1		
362.5															
337.5	1	1	1			3	2	2	3						
312.5				1	1	1	1	2	1			1			
287.5	2	1	1	1	1	4	3	8	4	2	3			1	
262.5															
237.5					1										

Grade X Academic Achievement, Percent.

Govt. Reading (c), Raw scores.	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140													1		
130										1				1	1
120											2	1			
110						1		1	1		1	1	1	2	
100				1				2			1	1			
90								2	1	1					
80			1		2	1	3	2	2	1	1	1	1		
70		2	2				2	1	3	6	1		1		
60					1	1	3	2	4	1	1	1	1		
50		1		2	3	4	3	4	2		2			1	
40	2		1	1			1	2	4	1					

Grade X Academic Achievement, Percent.

Govt. Reading (A), Raw Scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
90								1			1				
85								1	1						1
80							1		1			1		1	
75								1		1		1	1		
70		1	2				1	1		1	3	1	3	1	
65		1			3	1	1			6	2	1		1	
60			1		1	3	3	3	2	3	2	1			
55				1	1	1	3	7	3		1	1			
50		1			1	1	1	1	4	1				1	
45	1			1	1		2		2						
40	1		1	2				1	2				1		
35				1					1						
30															
25															

Grade XI Academic Achievement, Percent.

Laycock Intelligence Test, I.Q. pts.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140							1	1						
135									1		1			
130							1		1		3	1		2
125										3	1	1	2	1
120					3	2		1	6	1				
115			2	1			3	2	3		1			
110					1	2	5	1	1	2	2	2		
105			1			3		2	2					
100	1			1	1			1	2					
95				1			2	1						
90				1	1	3		2						
85			2											
80							1							

Grade XI Academic Achievement, Percent.

Willis - Smith Intelligence Test, I.Q. pts.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140														1
135									1		1	1		1
130					1		1		1				1	
125	1							1	2	2	2	1	1	
120			1		1	1	3	2	3	4	6	2	1	
115					1	4	4	2	4	1	1			
110			1		1		1	5	2	1				
105	1		1	1	1	2	2	1	3	1				
100				3		1	3	1	2	2				
95				2		3	2	2						
90			2		1	1								
85														

Grade XI Academic Achievement, Percent.

Henmon-Nelson (A), I.Q. pts.	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140							1							
135														1
130								1	3	1	1		1	
125	1				1		1		1	1	2	2	1	1
120				1	1	3	1	2	5	4	6	1	1	
115			2	2	1	2	3	4	4	2		1		
110				1	2	1	3	1	1		1			
105			1			4	1	1	2	2				
100			1	1	1	1	4	4	1					
95			1			1								
90														
85							1							

Grade XI Academic Achievement, Percent.

Henmon-Nelson (B), I.Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
145															1
140															
135												1	1		1
130						1		1		1			1	1	
125						1		1	3	4	3	3	2	1	
120			1		1		3	5	2	6	3	5		1	
115	1	1			1	1	2	2	3	3	3	1			
110				1	1	2	1	2	4	4	1				
105				1	1		2	3	1		1				
100				1	2		3		1						
95															
90								1							

Grade XI Academic Achievement, Percent.

Otis Intelligence Test, I.Q. pts.	30	35	40	45	50	55	60	65	70	75	80	85	90	95
135										1			1	1
130					1		3	1	3		5	3	2	1
125					1	2	3	3	5	4	3	1		
120			1		1	3	1	3	5	2	2			
115	1		2	1		2	6	3	3	3				
110				2	1	2		2	2					
105			1	1	1	1	1	1		1				
100					1		2							
95						1								

A.C.E. Intelligence Test, Raw scores →

Grade XI Academic Achievement, Percent ↑	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145
95															1			1
90										1		1		1				
85						1					1	1				1		
80							1	1	1	1			3	1		2		
75							3	1	2	1	1	2						
70		1		1	1	1		5	2	3	2							
65	1	1	1	1	2		1	2	2		1	1						
60	1	1	1		1	3	2	1	2	1				2				
55		1	2	3		1	2	1	1		1							
50			1				1	2		1	1							
45		3		1						1								
40			1		1	1		1										
35																		
30					1			1										

Grade XI Academic Achievement, Percent

Government Reading Test (V), Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
70														1
65					1				1		1			
60					1		2	2	1			2	1	
55			1		1	1		1	1	2	2		1	
50	2				1	2	1	1	5	2	4	2		
45				1		2	4	3	7	3	3		1	1
40			1	2	1	3	5	2	2	2				
35			2	1	1	3	4	3	2					
30			1	1		1		1		1				
25				1										
20								1	1					

Grade XI Academic Achievement, Percent

Government Reading (R) Test, Words per min.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
562.5							1		2	2	2			1
537.5							1		3					
512.5				1	1						1	1		
487.5								2	1					
462.5	1					4	2	3	3	3	4	1	1	
437.5			1			2		2	1		1		1	
412.5					2		4	2	2	4	2	1		
387.5						1	1							
362.5														
337.5				1	2		3		2			1		1
312.5			1			1		2	1					
287.5	1		3	2		2	3	2	3	2			1	
262.5														
237.5			1	1		2	1	1	1					
212.5					1									

Grade XI Academic Achievement, Percent.

Government Reading (C), Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
150							1							
140					1									
130									3			1		
120	1					1	2			3	4			
110								2	3	2	1	1	1	
100					1			2	3		2	1		1
90				1	1				1	2				
80			1			3	2	2	1	2	2			
70	1		1		1	3	3	2	1	1	1			
60				1		3	4	2	3			1	1	
50			1	2	1	1	3	2	1				1	
40			1	1		1		2	3	1				
30			1	1	1									
20							1							

Grade XI Academic Achievement, Percent

Government Reading (A) Raw Scores	30	35	40	45	50	55	60	65	70	75	80	85	90	95
95												1		
90														
85					1		1		1	2				
80	1					1	1			1	3	1	1	
75					1	1		2	2	2	1			
70	1		1		1	4	1	2	5		1	1		1
65				1	1		3	2	2	3	3			
60			1			1	2	2	4	1	1	1		
55			1				3	2	1	1				1
50				1		3	2	3	1		1		1	
45			1	2	2	1	2	1	1				1	
40				2		1			2	1				
35														
30			1											

Grade XI Academic Achievement, Percent

Nelson - Denny Reading Test (T), Raw scores.	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140							1							
130					1								1	
120									1					1
110							1		1	2	3	2		1
100					1			1	1		2	1		
90			1	1	1	1	2	3	4		2		1	
80	2				1	2	1	1	4	4	2	1		
70			2		1	6	4	3	3	3	1		1	
60				3		1	4	4	2	2				
50			2	1		1	3	1	2					
40				1	1	1		1	1					

Grade XII Academic Achievement, Percent.

Laycock Intelligence Test, I. Q. points.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
155									1						
150															
145															
140							1	1							
135									2	1					
130						1				1	2	1		1	1
125			2	1	1			1	1	1	2		2		
120					1		4	3		4		2			
115					4	4		2	4	2	2	1			
110					1	4	2	5	2			1	1		
105	1	1	1		2	1	1	1		2					
100		1			3	2	1	2		1		1			
95			1			1				1					
90			2	1		2		1							

Grade XII Academic Achievement, Percent.

Willis-Smith Intelligence Test, I.Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
145											1				
140									1					1	
135									3		1		2	1	
130							1	1	2			2			1
125			1		1	1	3	1	2	1	1	2			
120					3	2	3	3	2	3	4	3	1		
115				1	2	4	1	4	4	3	2				
110			1	1	1	4	2	3	2	2	1	1			
105			2		6	3	1	8	1	2					
100			2	2	5	5	1	2	1						
95		2	1		2	3	4			1					
90					1										

Grade XII Academic Achievement. Percent.

Henmon-Nelson Intelligence Test "A" I.Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140								1			1				
135												1			
130									3		3			1	1
125			1		1		1	2	4	1	1	1	2	1	
120	1		1	1	1	6	4	5	2	5	4	1			
115			2		5	3	3	3	2	3					
110		2	1	2	4	6		5	3	3		3	1		
105			2	1	2	3	3	2	1	1	1				
100				1	3	3	2	2							
95					1										
90							1								

Grade XII Academic Achievement, Percent

Hennon-Nelson Intelligence Test "B" I.Q. pts.	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
135						1		1						1	
130							2	1	3				1		1
125					1	1	2	2	2	5	3		1		
120				1	3	6	5	6	2	3	1				
115			1		2	7	1	1		1	1				
110			2		3	1	2	1	1			1			
105						2	1								
100		1	1												
95								1							

Grade XII Academic Achievement, Percent.

Otis Intelligence Test, I. Q. pts.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
135								1	1					1	
130						1	2	2	3	1	2		2		1
125				2	1	1	4	1	3	4	1				
120		2	1		2	5	3	4	1	4	1	2			
115					3	5	3	2			1				
110			1		1	3		1							
105			2			3		1							
100					1										
95															

Grade XII Academic Achievement, Percent.

American Council Intelligence Test, Raw scores

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
150									1			1		1	
140							1		1		1			1	
130			1		1		1	1	2	2	1	2	1		
120					3	1		4	4	2	2	1			1
110			1	1	1	5	3	3	3	6	4	2	2		
100	1				4	4	4	6	3	4	1				
90		1	1		5	4	2	4	1		1	1			
80			3	2	2	3	2	3							
70		1	1		1	1	1								
60				1			1								
50						2									

Grade XII Academic Achievement, Percent.

Nelson-Denny Reading "T", Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140							1	1	4						
130			1					1	1			2	1	1	1
120					2	1	1	1		3	4	1	2	1	
110					2	3	2	1	2	1					
100					1	3	3	2	3	3	4	2			
90				1	3	4	2	6	2	3	1	2			
80			2	2	2	6	1	4	3	3		1			
70	1	1	1		6	2	1	3	3	1	1				
60		1	1		1	2	2	2							
50			2	2	1	1	2	1							
40					1	1	1								

Grade XII Academic Achievement, Percent.

Government Reading (V), Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
70									2						
65			1		1	1	2	2	3		2		2		1
60				1	1	3	2	2	4	3	1	4	1	2	
55					2	7	2	6	1	4	3				
50			1	1	4	2	2	3	2	2	3	1			
45	1	1	2		4	4	3	3	2	3		1			
40					6	3	3	2	2	1	1	2			
35			1	1		2	1	4	2	1					
30		1	2	2	2		2								
25						1									

Grade XII Academic Achievement, Percent.

Government Reading (R), Words per min.	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
562.5			2	1	1			5	2	4	1	3		1	
537.5					1	3		4	3		2	1			
512.5		1		1	1	1	2	1	6						
487.5															
462.5	1		1		1	5	3	3	2	5	2	2	2	1	
437.5				1	6		4	1	1		2	1			
412.5			1	1	4	2	1	3	1	2	1				
387.5					1	2		1	1						
362.5															
337.5			1		1	4	4		2	1	1				
312.5		1	1		1	1		1				1			
287.5			1	1	3	6	2	2		2	1		1		

Grade XII Academic Achievement, Percent.

Government Reading (C), Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
160											1	1			
150			1					2	2	1		2			
140				1			3	1	3		1			1	
130		1			1			1	1	1	1	1	1		
120			1		2	1		3	3	4	2	1			
110					1	4	1	3	3		1	1			
100	1		1	1	3	2	1	2	2	2		1		1	
90			1		2	3	1		1		2	1	1		
80				1	4	3	3	3		3					
70					3	2	3		2	2	1		1		
60				1	1	1	2	2	1	1	1				
50			1	1		3	1	3							
40			2		1	2	1	1							
30		1			1	1									

Grade XII Academic Achievement, Percent

Government Reading "A", Raw scores.	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
95							1			1		1			
90							2	1			2		1		
85			1		1	1		3	4	2	1	4			
80		1	1		2	1		1	3	2	2	1		1	
75				1	5		2	4	3				1	1	
70				1	2	7	1	2	1	4	2	1	1		
65	1		1		3	2	3	2	5	2					
60			1	2	3	4	1	3	1	1	2				
55					1	2	4	2	1	2	1				
50					1	2	2					1			
45			3	1	1	2		2							
40						1	1								
35		1			1	1									

Grade X English Achievement, Percent.

Nelson - Denny Reading Test, Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
110												1		1	
100												3	1		
90			1					1	1	1	1		1		
80								2	1	3	3				
70						1	3	2	5	1	4		2		
60				1		1	3	4	4	5	5	3			
50		1		1	1	3	4	3	4		1				
40			1	2	2	6	2	4	1	1	2				
30		1	2			2									
20						1									

Grade X English Achievement, Percent.

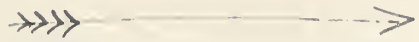
Govt. Reading (V), Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
60										2		1		1	
55								1	1		1	2			
50							1	2	1	1	4	1	1		
45						1		5	1	5	3	2	1		
40			1	1	1		5		6	2	3	1	1		
35				1	1		3	2	3		4				
30				1		2	2	2	3	1					
25		1	1		1	7		4			1				
20						3	1		1						
15		1		1		1									
10			1												

Grade X English Achievement, Percent.

Govt. Reading (R), Words per min.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
562.5			1						2		2	2			
537.5						1		1	1	1		1			
512.5							1		1		2		1		
487.5											1		1		
462.5						3	1	1	3	1	2			1	
437.5			1				2	2							
412.5					1	3		3	1	1	2				
387.5						1		1		1	1	2	1		
362.5															
337.5		1		1		2	2	3	2	1	1				
312.5				1		2		1		3	1	1			
287.5		1	1	3	1	2	5	4	6	3	4	1	1		
262.5															
237.5							1								



Grade X English Achievement, Percent.

Govt. Reading (C), Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95				
140												1							
130												2		1					
120									1		2								
110							1		1		4		2						
100			1					1	1	2									
90							1	1	1	1	1								
80						6		4	1		1	2							
70		1		1		1	4	2	3	2	3	1	1						
60				1	1	2		4	4	2	2		1						
50			2	1		5	5	3		3	2	1							
40		1		1	2		1	1	3	1	1								
30									1										

Grade X English Achievement, Percent.

Govt. Reading (A), Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
90							1				1				
85										2				1	
80						1				1	1	1			
75								1		1		2			
70		1		1		1	1	1	1	1	3	2	1		
65				1		2	3	2	1		3	1	3		
60				1	1	2		4	6	1	6				
55			2			4	2	6	1	1	1				
50						2	4		1	1	2	1	1		
45				1	1	2			2	1					
40		1	1				1	1	3	1					
35					1				1						

Grade XI English Achievement, Percent

Nelson-Denny Reading (T), Raw scores.	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140														1	
130							1							1	
120													1		1
110							1			1	1	3		2	1
100									1	1		2	1		1
90							1	1	4	5		4			
80				1		2		4	2	1	4	3	1		
70			1			1	4	6	7	3		3			
60			2	2		1	3	5	3	2	1				
50		1		1	1	3	1	2	1						
40		1		2		1		1		1					
30															

Grade XI English Achievement, Percent.

Government Reading (V), Raw scores.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
70															1
65							1					2			
60							1		1	1	1	1	1	2	
55									2	1	2	2			1
50			1	1				4	2	4	2	4	2	1	
45			1	1			1	6	5	5		3		1	1
40			1	1		2	5	5	4	1		2			
35				2		4	3	3	1	2	1				
30					1	1		1	2						
25		1		1				1							
20						1			1						

Grade XI English Achievement, Percent

Government Reading (R), Words per min.

	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
562.5		1								2		2	1	1	2
537.5										1	1	2			
512.5			1				2					1		1	
487.5								1		1	1				
462.5						2	3	3	4	2	1	5	1		
437.5						1	1	1	4	1				1	
412.5			1	2		3	1	2	2	2		4	1	1	
387.5						1		1							
362.5															
337.5				1			1	2	1	1	2				1
312.5						1	1	2	1						
287.5			1	2	1		2	6	3	3	1				
262.5															
237.5						1	1	1	3	1					
212.5				1											

Grade XI English Achievement, Percent.

Government Reading (C) Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
150													1	
140						1								
130									1		1	1	1	
120						1	1	2	3	1	3			1
110							1	1	2	1	3		2	
100			1		1		1	1	1		2	2		1
90		1				1	1	2	1		1			
80	1				2		5	3		1	2			1
70					1	3	4	1	1	1	1			
60		1	3		2		2	3	1	2	1			
50		1	1		1	2	1	4	2					
40			1	1	1	2	3	1	2					
30			1			1	1							
20							1							

Grade XI English Achievement, Percent.

Government Reading (A), Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
95													1	
90														
85						1		1		1	2			
80						1	1	1	1	1		1	3	
75							2	3	3		2			
70			1		2		3	3	4		2	2		1
65			1				2	2	2	1	4			1
60		1			1	1	4	2		3	2			
55			1		1		2	2	1					1
50			1		1	3	2	3	2		1			
45		2	1		3	4					1			
40				1			3	1	1					
35														
30						1								

Grade XII English Achievement, Percent

Nelson-Denny (T), Raw scores	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
140								1				3		1	
130									1		1	3		1	1
120							1		1		3	7	2		1
110					1			2	2	3				1	
100							4		4	4	7	2			
90						1	3	4	5	7	2				
80				3		3	2	2	5	6		1			
70			3	2	3	3	3	3	2	1	1				
60				1	2	2	2	1							
50			1	2	2		4	1							
40		1		1		1									

Grade XII English Achievement, Percent.

Government Reading (V), Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
70							1							
65							1		1	2	6	2	1	2
60				1			2	4	2	5	6	2	1	
55		1				4	2	5	3	5	2			
50					1	3	1	2	7	3	2			
45	1	1	1	3	1	2	2	7	4	1				
40			2	2	3	3	2	3	4					
35		1	2		2	4	2	1						
30		1	3	1	1	2	1							
25			1											

Grade XII English Achievement, Percent.

Government Reading (R), Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
562.5			1			1	1	4	2	2	4	1	1	
537.5						3		2	2	1	5			1
512.5					2	2	1	1	2	1			1	
487.5														
462.5		1	3		1	2		4	7	3	5		1	
437.5				1	2	2	2	1	2	2	2			
412.5			1			2	4	4	3	2				
387.5						3	1		1					
362.5														
337.5			2	2		1	1	5		2	1			
312.5		1		2	1	1				1				
287.5	1	1	1	3	1	2	4	1	1	2		2		

Grade XII English Achievement, Percent.

Government Reading (C), Raw scores.

	30	35-	40	45-	50	55-	60	65-	70	75-	80	85-	90	95-
160											1			
150									2	3	2			
140							2		1		3	1	2	1
130					1			4	1		1			
120			1		1	1	2	3	3	2	2			
110					1	5		3	2	2	1			
100					1	4		4	3			1		
90		1	2			3				1	4			
80				2	2	1	5	2	3	3	1			
70			2			2		3	3	2	2	2		
60				2		1	3	2	1	1	1			
50		1	3	1	1	2	1	1						
40		1	1	1	1		1	1		1				
30	1			1	1									

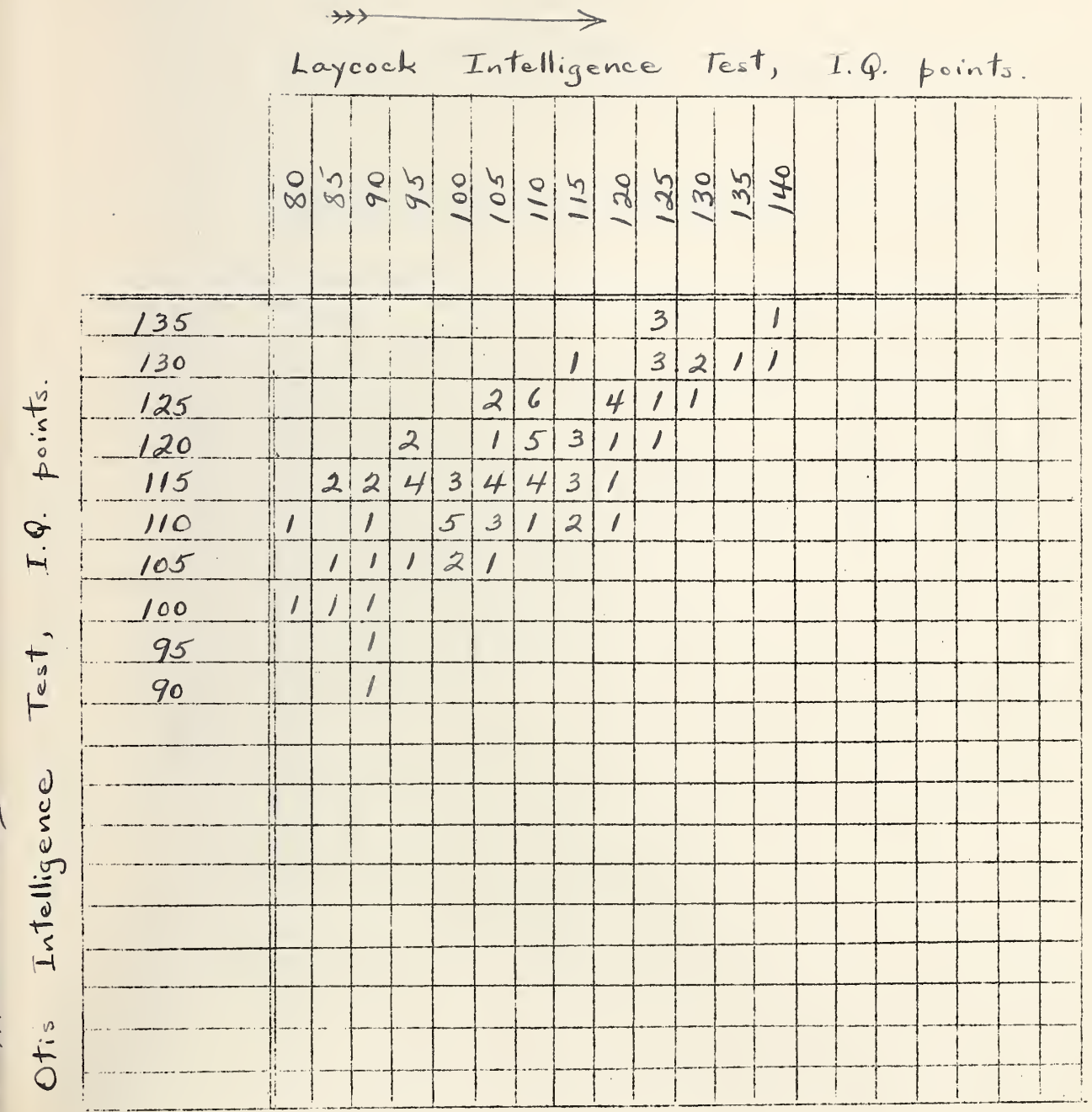
Grade XII English Achievement, Percent.

Government Reading (A), Raw scores.

	30	35	40	45	50	55	60	65	70	75	80	85	90	95
95							1			1	1			
90							1	1	1	1	2			
85						3	1	5	4	1	2		1	
80	1			1		2	1	1	2	3		1	1	1
75						1	1	1	4	1	2	3		
70				1	2	1	1	5	3	2	3			
65			3			4	2	5	1	1	2			
60		1	1	1	1	4	3	1	2	1	1			
55			1	1	2	1	1	1	2	3	3			
50		1	1	1		2			2					
45		1	2	1		1	2	2						
40				1						1				
35	1			1	1									

APPENDIX C.

Scatter-diagrams used to Calculate Relationships between Selected Predictive Tests.


Laycock Intelligence Test, I.Q. points.
80 85 90 95 100 105 110 115 120 125 130 135 140
135 3 1
130 1 3 2 1 1
125 2 6 4 1 1
120 2 1 5 3 1 1
115 2 2 4 3 4 4 3 1
110 1 1 5 3 1 2 1
105 1 1 2 1
100 1 1 1
95 1
90 1
Otis Intelligence Test, I.Q. points.

Henmon–Nelson (B), I.Q. points.

Henmon–Nelson (A), I.Q. points.

	85	90	95	100	105	110	115	120	125	130	135	140	145
140										1			
135													1
130								1	3	1			
125						1		3	4	1			
120				1		2	5	7	3	2	2		
115					1	4	2	3	3				
110				1	3	1	3	4	1				
105				1	1	2	2	1	1				
100					3	3	2						
95				1	2								
90													
85		1											

A.C.E. Intelligence Test, Raw Scores.

Henmon – Nelson (A) I.Q. points.

	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145
140								1										
135															1			
130				1				2			1							
125					1			1	1	2								
120		1	1	2		1	2	5	1	1			1			1		
115		3	1	1		4		2				1						
110				2			3											
105			2			3												
100	1	2	2				1		1									
95				1														
90																		
85			1															

Laycock Intelligence Test, I.Q. points.

Willis-Smith Mental Test, I.Q. points.

	90	95	100	105	110	115	120	125	130	135	140	145	150	155						
145																				
140														1						
135					1			2	2	1										
130					1		1		2		1									
125		1			1	1	3		1	1										
120					2	4	3	4	3		1									
115		1	1	1	3	5	2	1												
110		1	2	1	3	3	2	3												
105	2	1	2	2	2	3	2			1										
100	1		3	1	1	2		1												
95	3		2	3	1															
90																				
85																				

Grade X Govt. (A), Raw scores.

Nelson – Denny, Raw scores.

	35	40	45	50	55	60	65	70	75	80	85	90
110									1		1	
100							2	1		1		
90					1	1	1	2				
80				2	2	2	1	1	1	1		
70			2		2	6	5		1		1	1
60		2	2	5	4	2	1	6	1	1	1	1
50	2	2	1	3	3	4	2	2				
40		3	1	2	5	5	4	1		1		
30		1		1	1			1				
20						1						